

WHAT IS CLAIMED IS:

1. A tap coupler device comprising:

a substrate;

one or more main waveguides formed in the substrate for carrying optical

5 signals;

one or more tap waveguides formed in the substrate, each tap waveguide corresponding to 2 main waveguide; and

one or more waveguide tap couplers formed in the substrate, each coupler corresponding to a main waveguide for diverting a portion of an optical signal from 10 the main waveguide to the corresponding tap waveguide.

15 2. The tap coupler device of claim 1, wherein the one or more waveguide tap couplers is a Y junction tap coupler formed by an end of the tap waveguide joined to a portion of the main waveguide.

3. The tap coupler device of claim 1, wherein the one or more waveguide tap couplers is a directional tap coupler formed by a curved portion of the tap waveguide which approaches without crossing the main waveguide, wherein a portion of the tap waveguide is substantially parallel to a portion of the main 20 waveguide at a point of closest approach to allow evanescent coupling of optical signals from the main waveguide to the tap waveguide.

4. The tap coupler device of claim 1, wherein each main waveguide has an input end formed on an input surface of the substrate for coupling optical signals into the 25 main waveguide.

5. The tap coupler device of claim 1, wherein each main waveguide has an output end formed on an output surface of the substrate for emitting optical signals from the main waveguide.

6. The tap coupler device of claim 1, wherein each tap waveguide has an output end formed on an output surface of the substrate for emitting the diverted optical signals from the tap waveguide.

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7. The tap coupler device of claim 1, wherein each main waveguide has an output end formed on an output surface of the substrate for emitting optical signals from the main waveguide, and each tap waveguide has an output end formed on a surface of the substrate other than the output surface for emitting the diverted optical signals from the tap waveguide.

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8. The tap coupler device of claim 1, wherein each tap waveguide has an output end that terminates within the substrate for radiating the diverted optical signals through a top surface of the substrate.

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9. The tap coupler device of claim 8, further comprising one or more receiving optical fibers mounted on the top surface of the substrate, wherein an input end of each receiving fiber is disposed near the output end of a corresponding tap waveguide for receiving the diverted optical signals emitted from the tap waveguide.

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10. The tap coupler device of claim 9, wherein the receiving fibers are multimode fibers.

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11. The tap coupler device of claim 1, wherein the one or more main and tap waveguides are single mode waveguides.

12. The tap coupler device of claim 1, wherein the portion of the optical signal diverted to the tap waveguide is less than about three percent of power in the main waveguide.

- 5 13. A tap coupler device of claim 1,
 wherein each main waveguide has an input end formed on an input surface of
 the substrate and an output end formed on an output surface of the substrate;
 the device further comprising:
 an input block which includes a substrate and one or more input optical
10 fibers held fixed in the substrate, each input fiber having an output end disposed on
 an output surface of the input block, wherein the input block is disposed such that
 its output surface faces the input surface of the substrate of the tap coupler device
 to provide registration between the output ends of the input fibers and the input
 ends of the main waveguides for coupling optical signals from the input fibers to the
15 main waveguides; and
 an output block which includes a substrate and one or more output optical
 fibers held fixed in the substrate, each output fiber having an input end disposed on
 an input surface of the output block, wherein the output block is disposed such that
 its input surface faces the output surface of the substrate of the tap coupler device
 to provide registration between the input ends of the output fibers and the output
20 ends of the main waveguides for coupling optical signals from the main waveguides
 to the output fibers.

14. A tap coupler device comprising:

a substrate having one or more waveguides formed therein for carrying optical signals, each waveguide having an output end formed on an output surface of the substrate for emitting the optical signals from the waveguide, wherein the 5 output surface of the substrate including the output ends of the waveguides is inclined with respect to a plane normal to the direction of the waveguides at the output surface for reflecting a portion of the optical signals from the waveguides toward a top surface of the substrate; and

one or more receiving optical fibers mounted on the top surface of the 10 substrate, each receiving fiber being disposed at an angle with respect to the top surface and having an end disposed near the output end of a waveguide for receiving the portion of the optical signals reflected from the waveguide.

15. The tap coupler device of claim 14, further comprising a receiving block for 15 mounting the receiving fibers, wherein the receiving fibers are held fixed in the receiving block and the receiving block is attached to the top surface of the substrate.

16. The tap coupler device of claim 14, wherein the receiving fibers are 20 multimode fibers.

17. The tap coupler device of claim 14, wherein the output surface of the substrate including the output ends of the waveguides is free from anti-reflection coating.

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18. The tap coupler device of claim 14, wherein the waveguides are single mode waveguides.

19. The tap coupler device of claim 14, wherein the portion of the optical signal reflected toward the top surface of the substrate is less than about three percent of power in the waveguide.

5 20. A tap coupler device of claim 14 further comprising:
an output block which includes a substrate and one or more output optical fibers accommodated in the substrate, each output fiber having an input end disposed on an input surface of the output block, wherein the output block is disposed such that its input surface faces the output surface of the substrate of the
10 tap coupler device to provide registration between the input ends of the output fibers and the output ends of the waveguides for coupling optical signals from the waveguides to the output fibers.

15 21. A tap coupler device comprising:
a substrate;
one or more main waveguides formed in the substrate for carrying optical signals; and
one or more means formed in the substrate each corresponding to a main waveguide for tapping a portion of an optical signal from a main waveguide.

20 22. The tap coupler device of claim 21, wherein each means for tapping comprises a tap waveguide formed in the substrate, an end of the tap waveguide joined to a portion of the main waveguide to form a Y junction tap coupler to divert a portion of the optical signal from the main waveguide to the tap waveguide.

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23. The tap coupler device of claim 21, wherein each means for tapping comprises a tap waveguide formed in the substrate, the tap waveguide having a curved portion which approaches without crossing the main waveguide, a portion of the tap waveguide being substantially parallel to a portion of the main waveguide at a point of closest approach to form a directional tap coupler to allow evanescent coupling of optical signals from the main waveguide to the tap waveguide.

24. The tap coupler device of claim 21, wherein each means for tapping comprises:

10 an output end of the main waveguide formed on an output surface of the substrate, wherein the output surface of the substrate including the output end of the main waveguide is inclined with respect to a plane normal to the direction of the main waveguide at the output surface for reflecting a portion of the optical signals from the main waveguide toward a top surface of the substrate; and

15 a receiving optical fiber mounted on the top surface of the substrate, the receiving fiber disposed at an angle with respect to the top surface and having an end disposed near the output end of the main waveguide for receiving the portion of the optical signals reflected from the main waveguide.

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25. A tap coupler device comprising:

an input block which including a substrate holding fixed therein one or more input optical fibers, each input fiber having an output end disposed at an output surface of the input block for emitting optical signals from the input fiber, wherein
5 the output surface of the substrate including the output ends of the input fibers is inclined with respect to a plane normal to the direction of the input fibers at the output surface for reflecting a portion of light signals from the input fibers toward a surface of the substrate; and

one or more receiving optical fibers mounted on the top surface of the
10 substrate, each receiving fiber being disposed at an angle with respect to the top surface and having an end disposed near the output end of an input fiber for receiving the portion of the optical signals reflected from the input fiber.

15. The tap coupler device of claim 25, further comprising a receiving block for mounting the receiving fibers, wherein the receiving fibers are held fixed in the receiving block and the receiving block is attached to the top surface of the substrate.

20. The tap coupler device of claim 25, wherein the receiving fibers are multimode fibers.

25. The tap coupler device of claim 25, wherein the output surface of the substrate including the output end of the input fibers is free from anti-reflection coating.

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29. The tap coupler device of claim 25, wherein the input fibers are single mode fibers.

30. The tap coupler device of claim 25, wherein the portion of the optical signal reflected toward the top surface of the substrate is less than about three percent of power in the input fiber.
- 5 31. A tap coupler device of claim 25 further comprising:
an output block which includes a substrate and one or more output optical fibers held fixed with respect to the substrate, each output fiber having an input end disposed at an input surface of the output block, wherein the output block is disposed such that its input surface faces the output surface of the substrate of the
10 tap coupler device to provide registration between the input ends of the output fibers and the output ends of the input fibers for coupling optical signals from the input fibers to the output fibers.

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